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Complete improvement in a patient with multiple irreversible defects of the left ventricle on 99m technetium-sestamibi SPECT after percutaneous coronary intervention

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Abstract. – 99mTc-sestamibi has been investigated as a potential viability marker; initial studies have shown good concordance between 201Tl and 99mTc-sestamibi activities in both viable and nonviable myocardium. However, assessment of myocardial viability by 99mTc-sestamibi remains controversial for tissue recovery after revascularization. Here, we present a patient with several regions of severely diminished and irreversible (defect persisting in both early and delay images of each set scanning) defects on initial scan which were dissolved completely on the follow up scan after an intervention. In a 75 year-old Asian woman with acute myocardial infarction who received thrombolytic therapy and subjected to percutaneous coronary angiography (PCI) on day 28 after acute myocardial infarction(MI), resting 99mTc-sestamibi SPECT was applied on day 4 (initial scan) and 138 (follow up scan) after acute MI at 30 and 180 min after injection of tracer (740 MBq); Two-dimentional echocardiography was carried out at the same time. On the initial image set, there was irreversible defects in the apex, anteroapical, inferoapical, anteroseptal, septal and also anterior walls, while the follow up image was normal in all regions.The angiography intervention showed just significant stenosis on left anterior descending (LAD) vessel (95%). This may highlight the failure of 99mTc-sestamibi as a marker of myocardial viability and also mandate further validating of the procedure with follow up scan or other modalities for myocardial viability investigation.

Key Words:
Technetium-sestamibi SPECT, Myocardium, Left ventricle, Percutaneous coronary intervention (PCI).

Abbreviations

PCI = percutaneous coronary intervention;
MII = myocardial infarction;
LADI = left anterior descending;
PETI = positron emission tomography;
SPECTI = single photon emission computed tomography;
ECGI = electrocardiogram;
EFI = ejection fraction;
LVDDI = left ventricular end-diastolic cavity dimension;
201TlI = thallium-201;
FDG-PETI = fluorodeoxyglucose positron emission tomography

Introduction

Assessment of myocardial viability in patients with an acute coronary artery disease plays an important role in making decision to refer these pa-

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tients for coronary revascularization. Positron emission tomography (PET) is considered by some to be the gold standard to ascertain the presence of myocardial viability[1], but its high cost and limited availability may prevent its using as a routine practice modality. Heretofore, 201Tl has been considered the preferred agent to detect viable myocardium, with one of several possible imaging strategies[2]. 99mTc-sestamibi has also been investigated as a potential viability marker. Initial studies have shown a good concordance between 201Tl and 99mTc-sestamibi activities in both viable and nonviable myocardium[1]. However, assessment of myocardial viability by 99mTc-sestamibi remains controversial for tissue recovery after revascularization[3,4].In our study concerning resting 99mTc-sestamibi single photon emission computed tomography (SPECT) in the recovery of myocardial function in patients with acute myocardial infarction[5], we found a patient with several regions of severely diminished and irreversible defects on initial scan which were dissolved completely on the follow up scan after an intervention. This case presentation may indicate 99mTc-sestamibi as a myocardial viability marker along with further intensifying the need for 99mTc-sestamibi validating criteria for myocardial viability.

Case Presentation

In a 75 year-old Asian woman with acute myocardial infarction (MI) who received thrombolytic therapy after 4 hours onset of chest pain and subjected to percutaneous coronary intervention (PCI) on day 28 after acute MI, resting 99mTc-sestamibi SPECT was applied on day 4 (initial scan) and 138 (follow up scan) after acute MI at 30 and 180 min after injection of tracer (740 MBq). Two-dimensional echocardiography also was carried out at the same time[5]. She had diabetes mellitus (DM) and hyperlipidemia but she didn't have hypertension, smoking and also history of ischemic heart disease (IHD); creatine phosphokinase (CPK) was 548 IU/L. Based on the electrocardiogram (ECG), anterior MI and involvement of LAD territory was determined. On first echocardiography, ejection fraction (EF): 47 %; left ventricular end-diastolic cavity dimension (LVDD): 4.45; moderate anteroseptal hypokinesia and also echocardiography score: 4 was seen. Second echocardiography showed EF: 61%; LVDD: 3.77; mild septal hypokinesia without any valvular abnormality; also echocardiography score: 1. On the initial image set, there was irreversible defects in the apex, anteroapical, inferoapical, anteroseptal, septal and also anterior walls (Figure 1), while the follow up image was normal in all regions (Figure 2). The main scintigraphic data are shown in Table I. The angiography showed just significant stenosis on LAD vessel (95%). The patient underwent PCA on LAD.

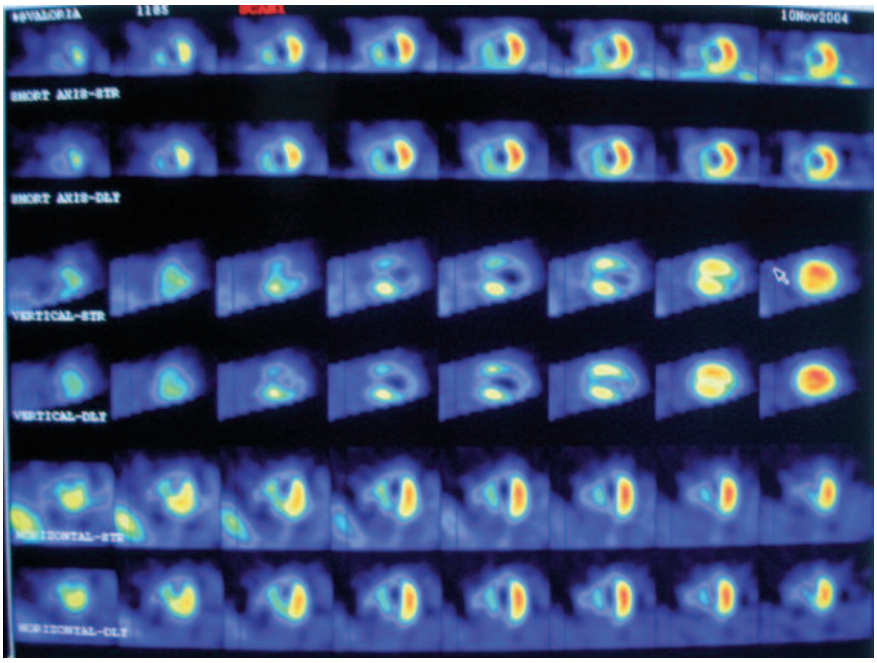

Figure 1. The initial set images of the patient showed irreversible defects in the apex, anteroapical, inferoapical, anteroseptal, septal and also anterior walls. The upper rows indicate 30 minute rest 99mTc-sestamibi SPECT images and lower rows 180 minutes rest 99mTc-sestamibi SPECT images.

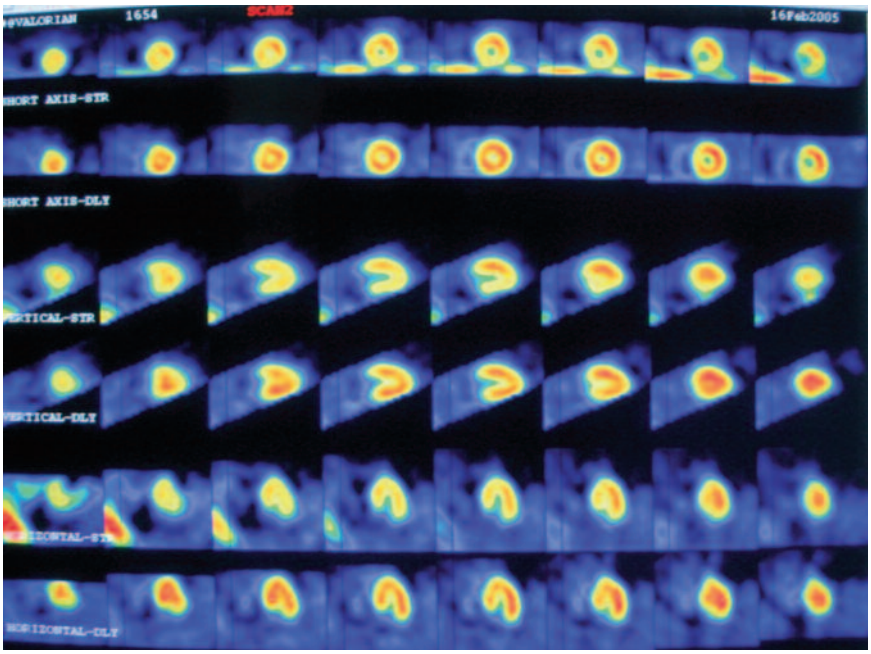

Figure 2. The follow up set images of the patient showed no abnormal perfusion. The upper rows indicate 30 minute rest 99mTc-sestamibi SPECT images and lower rows 180 minutes rest 99mTc-sestamibi SPECT images.

Discussion

There are several investigations regarding the role of Tc-99m sestamibi in determination of viable myocardium. A good correlation has been described between the quantified sestamibi activity and the extent of viable myocardium determined by morphometric studies[1,3]. In a previous study, there was a complete correlation between two agents in the prediction of viability[2]. Tc-99m sestamibi had a positive predictive value of 90% and a negative predictive value of 91% for improvement of left ventricular function[6]. In comparison of myocardial uptake of 201Tl with rest 99mTc-sestamibi uptake in 20 patients with a mean left ventricular ejection fraction of 33 ± 2%, comparable worth of rest 99mTc-sestamibi SPECT for viability assessment was suggested[7].

On the other hand, in patients with a previous MI, estimation of perfusion defect size determined by Tc-99m sestamibi exceeded that of 13N ammonia. The difference in defect size between Tc-99m sestamibi and 13N ammonia has been significantly greater in patients with viable vs. nonviable walls[8]. In addition, 18F fluorine-deoxyglucose (18F-FDG) evidence of viability had still been present in 50% of walls with 99mTc-sestamibi activity <40% and no significant difference in the 99mTc-sestamibi activity was described in viable and nonviable walls[8]. In another study, Altehoefer et al[4] investigated the

Table I. The main scintigraphic findings of the patient.

Percent uptake territory	30 min initial set	180 min initial set	30 min follow up set	180 min follow up set
SPS	35	32	0	0
LHR	0.28	0.25	0.29	0.29
CMR	0.114	0.084	0.476	0.438
LAD	37	40	82	78
RCA	50	51	73	80
LCX	78	80	84	8

SPS, sum perfusion score; LHR, lung heart ratio; CMR, cavity to myocardium ratio; LAD, left anterior descending artery; RCA, right coronary artery, LCX, left circumflex artery.

relationship between 99mTc-sestamibi uptake at rest and preserved or absent uptake of 18F-FDG in 111 patients with coronary artery disease, in which segments with a normalized 18F-FDG uptake >70% defined as viable while segments with a 18F-FDG uptake <50% were designated as nonviable. They concluded that myocardial 99mTc-sestamibi uptake seems to be a sign of myocardial blood flow rather than myocardial viability.

Although some works such as nitrate administration at rest phase, combined use of sestamibi perfusion/wall motion scan and the development of new software might improve the results in the setting of myocardial viability, a reliable judgment about myocardial viability cannot be made upon it solely[9]. The results of this case presentation concordantly suggest that 99mTc-sestamibi underestimates myocardial viability, compared to the accepted standards of thallium (rest-redistribution or stress-reinjection protocols), 18F-FDG PET and also in the prediction of left ventricular functional recovery after revascularization[10].

Conclusions

This case showed complete improvement of several irreversible defects on 99mTc-sestamibi scintigraphy, suggesting its underestimation of myocardial viability in the prediction of left ventricular functional recovery after revascularization. In addition, may show that patients with moderate and severe 99mTc-sestamibi defects at rest need additional studies prior to final therapeutic decisions.

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